"INCIDENCE AND RISK FACTORS OF SURGICAL SITE INFECTIONS IN ELECTIVE ABDOMINAL SURGERIES"

Dissertation submitted

To

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY, CHENNAI

In partialfulfillment of the regulations for the award of the degree of

M.S (General Surgery)

Branch-I

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation titled '**INCIDENCE AND RISK FACTORS OF SURGICAL SITE INFECTIONS IN ELECTIVE ABDOMINAL SURGERIES''** is a bonafide and genuine research work carried out by me under the guidance of Prof. P.N.SHANMUGASUNDARAM, MS, HOD of Department of General Surgery, Kilpauk Medical College, Chennai-10.

This dissertation is submitted to **THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY CHENNAI** in partial fulfillment of the degree of M.S. General Surgery examination to be held in **April 2015**.

Date:

Place: **DR R.SAMSON**

CERTIFICATE

This is to certify that this dissertation is the bonafide work of

DR .R.SAMSON

On

"INCIDENCE AND RISK FACTORS OF SURGICAL SITE INFECTIONS IN ELECTIVE ABDOMINAL SURGERIES"

During his course in M.S. General Surgery from September 2013 to September 2014 at Government Kilpauk Medical College, Chennai-10.

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This is to certify that the dissertation titled **"INCIDENCE AND RISK FACTORS OF SURGICAL SITE INFECTIONS IN ELECTIVE ABDOMINAL SURGERIES''** is a bonafide research work done by **Dr R.SAMSON**, post graduate in M.S. General Surgery, Kilpauk Medical College, Chennai-10 under my direct guidance and supervision in my satisfaction, in partial fulfillment of the requirements for the degree of **M.S.GeneralSurgery**.

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INCIDENCE AND RISK FACTORS OF SURGICAL SITE INFECTIONS IN ELECTIVE ABDOMINAL SURGERIES

INTRODUCTION :

Surgical site infection is a common postoperative complication. It prolongs hospital stay .It has a significant effect on postoperative morbidity and mortality. It also has a burden on patient's economy as well.

Surgical site infection can be considered under nosocomial infection. Nosocomial infections are encountered during prolonged hospital stay.

They even contribute to failure of surgery. An annualof 2 million cases of surgical site infection worldwide has caused concern.[(1).]

WHO describes nosocomial infections as major infectious diseases having a large impact on the economy [(2).]

Nosocomial occurs when there is a close relation between the medical professionals and the patients in different stages of treatment. It is very difficult to find the initial source of infection [(2).]

Such infections are preventable to an extent of about 25-36%by strict adherence to healthcare system by the medical professional while taking care of the patients[(1).]

There are several factors which influence whether the wound may ormay not go in for an infection.

They include

1.pre-existing co-morbidities,

2.duration of surgery,

3.wound class and

4.contamination of the wound.

Other associated factors are bimodal age groups,malnutrition,cigarette smoking, alcoholism, malignancy, metabolic diseases, immunosuppression,emergency procedures , other remote site infection, and prolonged hospital stay[(3).]

The disturbance in host- micro-organism equilibrium favours the entry of the micro organism. A wound infection is to be considered whenever there is a pus discharge within 30 days following surgery having a closed surgical incision and also with signs of inflammation around the surgical site irrespective of whether a microorganism can be cultured or not.[(3).]

The infected wound usually consists of varying aerobic and anaerobic species. The pus producing 'pyogenic' bacteria are usually involved in the surgical site infection. These septic events usually involve the urinary and the respiratory tracts or occur in the operative wound[(8)].

Clean surgeries like elective orthopaedic procedures have the lowest infection rates(<2%) where the source of contamination is exogenous or airborne .

Clean contaminated surgeries carry high rates of infection(10-20%)[2] because the operative sites in the surgery have an exposure to endogenous microorganisms.

A wound infection is common and most troublesome. Wound healing is delayed by wound infection.

Ever sincesurgery wasstarted as a treatment modality, postoperative surgical site infections have caused a great troublesome impactthat needs to be tackled. Recent advancements in medication enable us to counter attack the microorganisms involved in surgical site infection.

Surgeries in the pre antibiotic era that were considered impossible because of fear of infection were made possible with the advancements in newer medications.

REVIEW OF LITERATURE

Historical background:

As surgeons, though we deal with infections since the dawn oftime, our understanding to treat wound infections became clear only afterthe development of theory of antisepsis and the evolution of germtheory.

Many observations made by nineteenth century physicians werecrucial in our knowledge regarding the pathophysiology, treatment andprevention of surgical site infections.

Louis Pasteur formulated germ theory and elucidated thatcontagious diseases are caused by specific microbes. With the help ofthese principles, he pioneered techniques of sterilization.

Also, heidentified certain organisms responsible for human infections like *Staphylococcus*, *Streptococcus*, and pneumococcus.

Joseph Lister used a solution of carbolic acid, which was used totreat sewage in his times in Europe, to dress the patients. As this reducedthe post operative infection incredibly, it was quickly adoptedthroughout his country.

In 1880, **Robert Koch**, through his experiments, identifiedpathogenic organisms associated with specific disease like cholera andtuberculosis.

Koch's postulates :

A given organism is the cause of a given disease

It must be found in every case

It should be possible to isolate from the host and grow in culture.

It should reproduce the disease when injected into another healthy host.

It should be recovered from an experimentally infected host.

Charles Mc Burney pioneered the principle of source control (i.e,surgical intervention to eliminate the source and thereby treat theinfection) by performing appendicectomy as treatment of appendicitis,which was previously known to be a fatal disease. This was popularisedafter appendicectomy was performed on the King Edward VII of England, by **SirFrederick Treves.**

The discovery of effective antimicrobials helped the modernsurgeons to treat wound infections in a much better way during thetwentieth century.

During world war I**, Sir Alexander Fleming**, an armymedical officer in British Medical Corps identified the first antibacterialagent Penicillin through his works on the natural action of blood againstbacteria and sepsis. During his study on influenza virus, in 1928, he noticed a zone of inhibition around *Penicilliumnotatum*colony thatgrew profusely on a plate of *Staphylococcus*. He then named the substance derived as ***'penicillin'.***

This subsequently led to the development of hundreds of potent antimicrobial agents against infectious organisms, which set an examplefor their use as *prophylaxis against postoperative wound infection*, andbecame a very crucial component in the treatment of aggressive and potentially fatal surgical wound infections.

Prolific advances in the field of clinical microbiology paved way for the discovery of many new antimicrobial agents against those microbes.

Also the discovery of autochthonous microflora of skin,respiratory tract, and alimentary tract helped modern surgeons to enhance their knowledge about the organisms which will be encountered during surgery. However, whether these organisms were pathogenic or non-pathogenic remained unclear.

With clinical observations made by veteran surgeons, **Frank Meleny** and **William Altemier**, the fact that aerobes and anaerobes synergise to cause serious infections (soft tissue infections and intraabdominal sepsis) came into limelight. So the concept that inhabitant microorganisms were not pathogenic to human body vanished as these organisms have the potential to cause surgical infections when they enter a sterile cavity during the time of surgery.

Over the few last decades, new ideas ofthe polymicrobial nature of surgical Infections were propagated. Aspirates from the peritoneal fluid of patients with perforated viscus or gangrenous appendicitis also showedthe presence of aerobes and anaerobes.

Trials were conducted to know the effective source control to treat these infections and antimicrobial agents were administered targeting both pathogens and commensals.

William Osler, one of the pioneers of American Medicine, from his observations noted that patient died due to inflammatory response in the body to an organism. This allowed our insight into the host inflammatory response to infection. It is because of activation of multiple pathways in response to an infection. Many

new therapies were formulated targeting the modified inflammatory response. Exaggerated inflammatory response seems to be the cause of end organ failure and multi organ dysfunction.

Thus, treating surgical infections and thereby preventing multi organ failure is one of the challenges faced by surgeons.

PATHOGENESIS OF INFECTION:

Host defences:

Barrier

Microbial flora

Humoral responses

Cellular responses

Cytokine production

Defence barriers:

Physical barriers

Chemical barriers

Immunologic barriers

Mammalian host possesses intrinsic defence mechanisms that help prevent invasion of microbes, multiplication of organisms and thereby containing the infection.

Our host defences are highly regulated systems and are very effective in coping with the invaders. They include:-

1.Site specific defences (SSD)

2.Systemic defences

Site specific defences provide protection at tissue level.

Systemic defences begin immediately after invasion of pathogen

into sterile area of body.

Any micro organism will have to face number of barriers in the body.

1. Epithelial barrier
2. Mucosal barrier

Mucosal barriersare provided by mucosa of respiratory,gastrointestinal and urogenital system. Host barrier cells prevent invasion of microbes and proliferationby secreting certain substances. Skin commensals adherent to surface preclude virulent organism invasion, thereby offering resistance to colonisation by virulent pathogens.

PHYSICAL BARRIERS:

Skin:

Skin, the largest organ in the body provides the most extensive physical barrier.

Resident or commensal microflora on the surface of skin block the attachment of pathogens.

Some of the endogenous microflora include Staphylococcus, Streptococcus, Corynebacterium,Propionibacterium species. Also, Enterococcus faecalis, Enterococcus faecium, Escherichiae coli, Enterobacteriaceae and Candida albicans are isolated from skin surface below the umbilicus.

Skin diseases can be associated with abnormal proliferation of skin commensals.

Respiratory tract:

Host defences in respiratory tract help maintain sterile environment in distal bronchi and alveoli under normal circumstances.

Larger particles are trapped in the mucosa of respiratory tract which arelater cleared through cough.

Smaller particles reaching the lower respiratory tract are cleared by pulmonary macrophages through phagocytosis.

Any breach in this process leads to bronchitis or pneumonia.

Gastrointestinal tract:

Numerous microbes are encountered in many portions of gastro intestinal tract.

Places where resident micro flora are absent include urogenital, biliary and pancreatic ductal system under normal circumstances.

However, in case of inflammation, malignancy, stone formation or catheterisation, microorganisms may proliferate.

Vast number of microorganisms are found in oropharynx and colorectal region. But, organisms found in entire gastro intestinal tract are not always from oropharynx

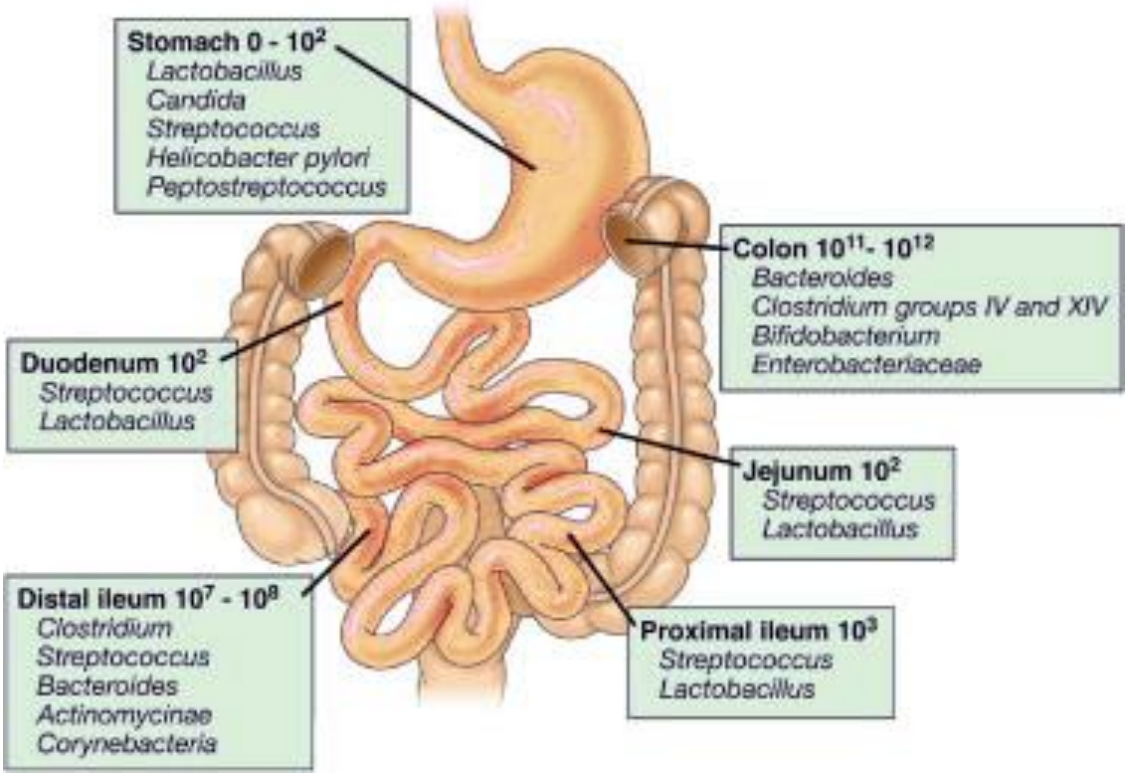
It is because of the following reasons:

1. Highly acidic environment in stomach kills the microbes.

2. Low motility in stomach during initial phases of digestion.

Thus, microbial population in stomach accounts to approximately $10^2$to 10^3 colony forming units (CFU). But this may be increased during disease states or drug intake .In terminal ileum, microbial proliferation occurs, increasing count to approximately $10^5$to 10^8CFUs. Exponential growth occurs in colon due to its relatively static and hypoxic environment, where aerobic species are outnumbered by anaerobic organisms to approximately 10:1.

MICROFLORA IN GASTROINTESTINAL TRACT



Part of GIT Microbial population(CFU/ ML)

Stomach $10^2$to 10^3

Small intestine $10^3$to 10^8

Distal colorectum $10^8$to 10^{12}

Along with facultative organism and obligate anaerobes like Bacteroides,

Lactobacillus, Clostridium, Fusobacterium and Eubacterium, some aerobic microbes like Escherichia coli, Enterococcus faecalis,Enterococcusfaecium, Enterobacteriaceae and Candida albicans are also present in the colon.

These organisms provide resistance to colonisation and prevent the entry of other organisms like Vibrio cholera, Shigella,Salmonella.

But when pathology like perforation occur, the commensal organism provide nidus of infection for the pathogens to proliferate. Surprisingly very little host organisms contribute to the intra abdominal infection.

When pathogens enter specific body compartments or tissue, defence mechanisms act to eliminate or remove the nidus of infection.

Apart from providing physical barrier, certain proteins like

1. Lactoferrin and Transferrin sequester microbial growth factor iron.

2. Fibrinogen in inflammatory fluid trap micro organisms and polymerises to fibrin.

3.Diaphragmatic pumping mechanism on the undersurface of diaphragm help in expunging micro organisms from peritoneal fluid.

4. Omentum, ‘the policeman of abdomen’ serves to limit infection.

Immunologic barriers:-

Defence mechanisms in tissues of the body ;-

a) Resident macrophages regulate cellular host defence.

b) Secretion of cytokines is upregulated by substances like TNF –

alpha, IL- 1 beta and INF Gamma.

When microbes interact with defence mechanisms in body, formation of membrane attack complex and intracellular destruction by formation of phagocytic vacuoles.

Complement pathways, both alternate and classical pathways get

activated after microbial invasion.

Release of complement fragment(C3a, C4a, C5a) increases vascular permeability. When microbial insult occurs, chemotaxis (i.e., attraction of neutrophils to the micro organisms to the site of insult) occurs. This further leads to the influx of inflammatory fluid to the area of insult. Diapedesis of neutrophils occurwithin minutes and it peaks within a period of hours or days.

Response to an infection depends upon several factors:

1)Number of micro organisms entering the body.

2) Proliferation of organisms

3) Virulence of organisms

4) Potency of defence mechanism

Invasion of microbes can lead to one of the following possibleoutcomes:

a) Eradication of infection

b) Limitation of infection (purulent infection is the hall mark ofchronic infection)

c) Locoregional infection (cellulitis, soft tissue infection)

d) Systemic infection (bacteremia)

Infection is defined as an 'identification of microorganisms in host

tissue or bloodstream, plus an inflammatory response to their presence'.

The inflammatory signs of 'rubor, tumor, calor, and dolor' are common,

at the site of infection.

Apart from these local manifestations, certainsystemic manifestations like increased pulse rate and respiratory rate, elevated temperature and elevated white blood cell (WBC) count also occur.

Above noted systemic manifestations comprise the '*systemicinflammatory response syndrome* '(SIRS).

"Sepsis is not an antibiotic deficiency syndrome"

SIRS when it is caused by microbial infection is termed as *sepsis*

and it is mediated by production of a cascade of numerous proinflammatory mediators produced in response to the products of microbial invasion. These products can be a lipopolysaccharide(endotoxin) derived from gram-negative bacteria; or a peptidoglycanand teichoic acid from gram-positive bacteria; multiple fungal cell wall components such as mannan and numerous others. Patients have sepsis if they meet the following clinical criteria for SIRS and have an evident local or systemic infection.

Severe sepsisis defined as sepsis along with the occurrence of new-onset failure of multiple organs.

It is the frequent cause of death in surgical intensive care units, with a very high mortality rate. i.e., when a patient with sepsis needs ventilatory support and is unresponsive to fluid resuscitation or one who requires vasopressors to correct hypotension, is considered to have severe sepsis.

Septic shockis a state in which patient has acute circulatory failure which is usually identified by the occurence of persistent hypotension (systolic blood pressure <90 mmHg)inspite of aggressive fluid resuscitation, with no other identifiable causes. It is the severe manifestation of infection. It can occur in approximately 40% of patients with severe sepsis. It has a very high mortality rate.

PATHOGENS OF INTEREST FOR SURGEONS:

1. BACTERIA

These are little organisms which are of great importance for the

surgeons, as they form the vast majority of surgical site infections.

Cell wall staining:

There are a number of species of bacteria which are identified by a specific staining called Gram's stain.

This staining imparts specific colour to bacterial cell wall through which it is classified as gram positive and gram negative.

a) When they stain purple, they are termed as gram-positive bacteria.

b) And when a bacteria stains red, it is termed as gramnegative

Growth characteristics:

Every bacteria has certain specific growth characteristics

in its specific media.

Based on a number of some characteristics, bacteria can be further classified.

Classification is based on

a) **<u>Morphological characteristic</u>**

Cocci

Bacilli

Spirochetes

b) **the pattern of multiplication** - single or multiplication in groups of organisms, i.e., in pairs (diplococci) or in clusters (staphylococci), or in chains of organisms. (streptococci).

c**) the presence of spores and its location**.

Terminal spores

Subterminal spores

Gram-positive bacteria

The bacteria that cause surgical site infections are:

a) skin commensals

Staphylococcus aureus and

Staphylococcus epidermidis and

*Streptococcus pyogenes*and

These organisms cause infections either alone or in combination with other pathogenic organisms

b) *commensals of GIT* such as

*Enterococci faecalis*and

Enterococci faecium.

They have the capability to cause nosocomial infections like respiratory infections, catheter associated infections urinary tract infections (UTIs) and septicaemias in immunologically compromised or chronically debilitated patients. But in healthy individuals, these are of little importance.

Gram-negative bacteria:

The organisms which a surgeon isspecially interested among gram negative species include:

E. coli,

Proteus vulgaris and mirabilis

Klebsiellapneumoniae

Serratiamarcescens

Pseudomonas aeruginosa, P. fluorescens.

Enterobacter

Anaerobic organisms

• These organisms are not able to multiply or divide in the presence of atmospheric air.

• This is because of the absence of the enzyme catalase, which is important for the metabolism of reactive oxygen species.

• They are the predominantly available in many areas of the human body, including oropharynx and colorectum among which flora in oropharynx is different from the one in colorectum

C. Perfringens

C.difficile

C. tetani

C. Septicum or novyi.

Bacteroidesfragilis

Propionibacterium

*Fusobacterium*spp.

Other bacteria of interest to surgeons include:

Mycobacterium tuberculosis

*M. avium-intracellulare*and*M. Leprae.*

Nocardia

• These are acid fast and are very slow growing bacilli.

• They are not easily cultivated in laboratory and need specificculture media to grow which may take several weeks to months.

• They are notorious in causing severe pulmonary and extrapulmonary infections which are still prevalent in our country.

SURGICAL SITE INFECTIONS

The term ‘SURGICAL WOUND’–was replaced by ‘SURGICAL

SITE INFECTION’. This term was formulated by CDC in 1992.

CATEGORIES OF SSI

SSI were categorized into two,

1. Incisional SSI

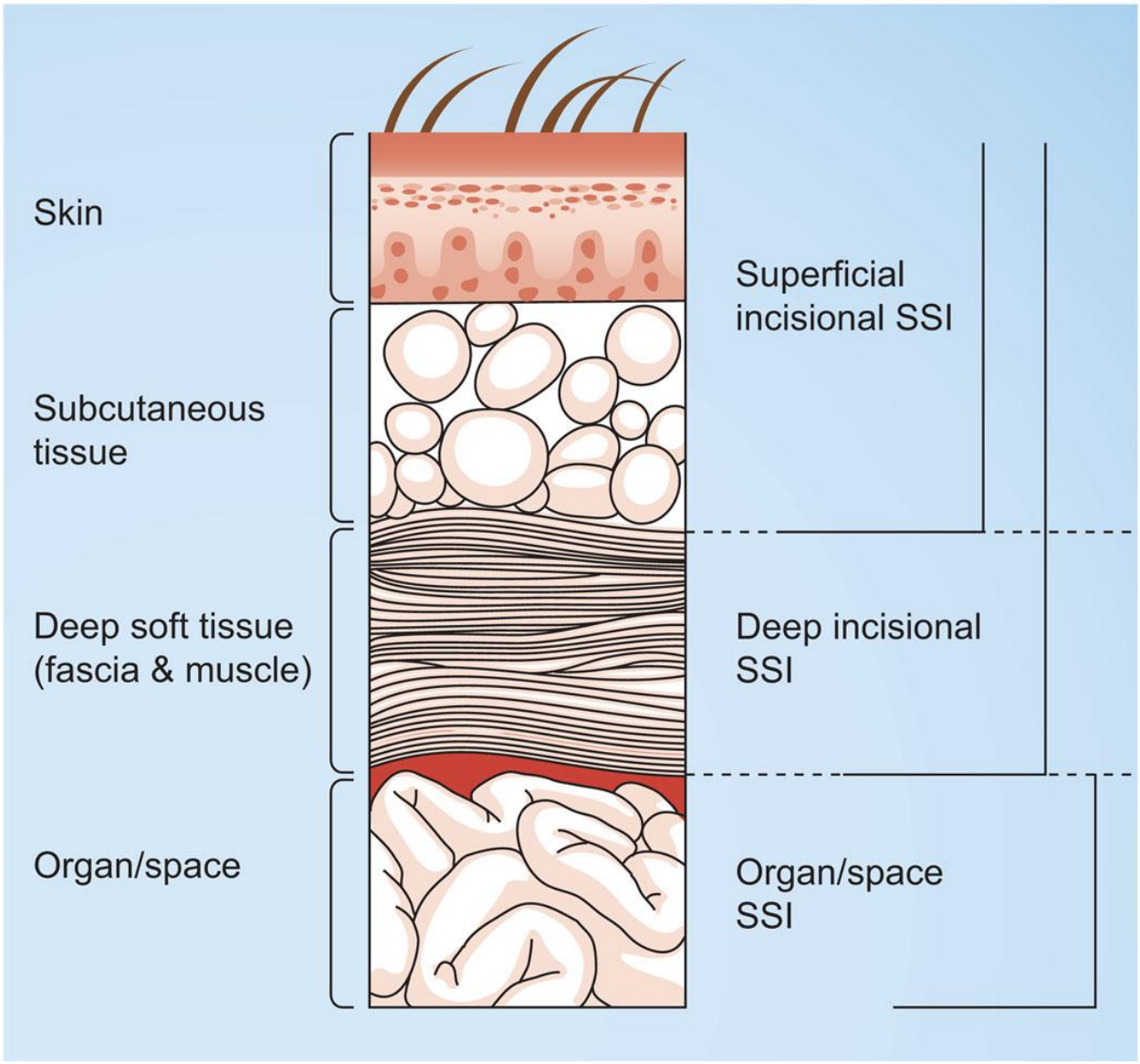
» Superficial

» Deep

2. Organ/space SSI.

Of surgical infections, 60 to 80% are incisional and the remainder are organ/space infections.

CATEGORIES OF SURGICAL SITE INFECTION



SUPERFICIAL SSI

A superficial SSI can be defined as 'An Infection occuring within 30 days of surgery and it involves only the skin and subcutaneous tissue of incision'.

It includes:

• Purulent aspirate from the site of incision associated with or without positive culture

• Local signs of infection and inflammation – pain, tenderness,localised swelling, redness & heat.

- Micro organisms obtained from the culture of fluid or tissue taken aseptically from a superficial incision

• Diagnosis of superficial infection made by the surgeon

Conditions which should not be considered as SSI include:

1. Stitch abscess

2. Episiotomy wound

3. Infection at the site of circumcision in a new born child.

4. Infected burn wound

DEEP INCISIONAL SSI

Deep incisional SSI can be defined as ‘An Infection that is occurring within 30 days of surgery (1yr if an implant is in place) and infection involving deep soft tissues.

It usually includes:

• Purulent discharge from the site of deep incision.

• Fever of 38 degree celsius or More.

• Local pain / tenderness at the incision site and incision dehiscesspontaneously or is opened deliberately.

• Abscess or other evidence of infection which involves the deep incision and found on direct examination / visual / radiological /histological examination.

• Diagnosis made by the physician / surgeon

ORGAN / SPACE SSI

An organ or space SSI can be defined as ‘An Infection occurring within 30 days (1yr of implant) or Infection involving any other part of the anatomy other than that of the incision site which was opened / manipulated at the time of surgery.

It may include :

• Purulent aspirate from the organ / space operated which is

identified by a drain

• Micro organisms from the culture obtained aseptically

• Infection identified during reoperation / Histological examination/ imaging.

SURGICAL WOUND SITE SURVEILLANCE:

Surveillance of wound site is usually done by

a) sterile dressing for 24-48hrs after surgery .

b) washing hands before and after changing dressing.

PREPARATION OF PATIENT :

Before preparing the patient for an elective operation, the following steps must be undertaken.

_ Identify and treat infections away from the surgical site before operation.

_ Keep the pre-operative stay as short as possible

_ Proper control of blood glucose levels

_ Ask the patient to take a bath before the surgery.

_ Do not remove hair unless it interferes with operation and if required, remove with electric clippers immediately before operation.

_ Abstain from any forms of tobacco or alcohol consumption prior to operation

_ Apply antiseptic agent in concentric circles moving towards periphery.

PREPARATION OF THE OPERATING TEAM

1. Nails should be kept clean and short

2. Surgeon should not wear any rings or hand jewellery

3. Preoperative surgical scrub for 5 minutes

4. Scrub the hands till elbows for a surgical hand washing

5. Water should always flow from hands towards elbow after a scrub

6. Always use a towel, gown and gloves which is sterile

How to manage when a person in surgical team is infected?

_ Educate them to report to the team head

_ Developing well-defined policies concerning patient care

_ Surgical personnel with draining skin:

_ Must provide and collect cultures

_ Abstain from duty, until infection has been subsided

_ or adequate antimicrobial therapy provided

Principles of prophylaxis:

Use of multiple methods (physical, chemical, and antimicrobial therapies) or a combination of these to decrease the presence of exogenous factors (surgeon and operating room environment) and endogenous factors (microorganisms) is called *prophylaxis*

Effective Source control:

The primary concept in the treatment of surgical site infections includes:

- drainage of pus
- wound débridement including infected and devitalized tissue
- extrusion of foreign bodies
- treatment of the root cause of infection

Antibiotic Prophylaxis:

Antibiotic prophylaxis was first proposed by Miles and Burk in 1950.

Prophylaxis should be planned so that it is administered at the time of induction or skin incision. Because,

• after 3 hrs of entry of infectious agent, it becomes very ineffective.

• Concentration of organisms > 100,000 / gm of tissue usually exceed the capacity of host defence.

• In the body, Humoral or cellular mechanisms defeat bacteria.

What are the Principles behind prophylaxis?

• Always use the antibiotic agent which is likely to cause the probable infection

• Use full dose of any antibiotic chosen

• Administer the chosen drug prophylactically

• If duration of operation is prolonged for more than 3 hrs, give another dose of the chosen antibiotic.

• Employ post operative antibiotic, when the risk of infection is increased.

Antibiotic prophylaxis and its possible risks :

For patients giving a history of allergy, urticarial, rashes, bronchospasm, hypotension, local swelling, laryngeal oedema occurring even after a single dose of penicillin injection have a potential risk of anaphylaxis (type I immediate hypersensitivity).

So recommendation of beta-lactams as a prophylactic antibiotic is highly condemnable.

Alternate antibiotic has been formulated for patients giving a history of allergy to Penicillins/ Cephalosporins.

These are very important as far as the patient's safety is concerned, failure of which may lead to a disaster.

WHO Model List – 2003

This list contains only 25 essential antibiotics for controlling

most of the surgical site infections.

For routine use – 19 antibiotics were recommended.

For complementary use – 6 have been recommended

NARROW SPECTRUM AGENTS

- **Gram positive agents include:**

Penicillin

Cloxacillin

Erythromycin

Clindamycin

Vancomycin

- **Gram negative**

Gentamycin

Ciprofloxacin

Spectinomycin

Nitrofurantoin

Nalidixic acid

Ceftriaxone

Ceftazidime

• **EXTENDED SPECTRUM ANTIBIOTICS**

It includes antibiotics for both Gram + ve and Gram –veorganisms.

Ampicillin

Amoxycillin

Cotrimoxazole

Trimethoprim

Sulphadiazine

Amoxicillin + clavulanic acid

Imipenam +cilastatin

BROAD SPECTRUM ANTIBIOTICS

Doxycycline

Chloramphenicol

For Anaerobic infections:

Metronidazole

SURGICAL ATTIRE AND DRAPES

_ Cover the nostrils and mouth using a mask inside the theatre

_ Until the surgery is over, it is essential to wear a mask.

_ Cap that is worn must fully cover the hair of the surgeon and assistant.

_ Gloves used must be sterile.

_ Gloves are worn after surgical draping

_ Contaminated or a visibly unsterile surgical gown must not be worn and is always discarded

_ Strict aseptic technique must be maintained.

_ It is important to thoroughly wash the wound so that devitalized or dead tissue is effectively debrided.

_ Foreign body when present must be removed immediately

_ Perfect hemostasis must be maintained

_ It is advisable that a heavily contaminated wound is left open and

is allowed to close by secondary intention.

_ It is essential to maintain wound hygiene. Post-operative care of

the incision must be done and kept clean

RISKFACTORS OF SURGICAL SITE INFECTION

The risk factors associated with surgical site infection can be:

I. ENDOGENOUS FACTORS

II. EXOGENOUS FACTORS

Endogenous(patient related) factors:

This includes:

1. Duration of pre operative stay of a patient in the hospital

2. Presence of any previous infection in patient

3. History of previous Abdominal operation

4. Age of the patient >50 years or < 1 yr

5. An Obese patient

6. History of Diabetes Mellitus in patient

7. Immunocompromised state or Malnutrition

8. Altered immune response

9. Usage of Tobacco

Exogenous (Perioperative factors):

The exogenous risk factors which also contribute to surgical site infection include the following:

• Prophylactic Antibiotic given to the patient before a surgery or procedure.

• Period or length of surgery – if the duration exceeds more than 3hours, additional dose of antibiotic must be given

• Ventilation of an operating room

• Technique handled by the operating surgeons – usage of cautery cautery, obtaining perfect haemostasis, trauma

• Asepsis and Proper sterilization of instruments

• Length and duration of surgical scrub using betadine or alcohol

(2-5minutes)

• Antisepsis of skin, though removal of hair is controversial in

causing SSI, it may contribute to SSI

• Presence of a foreign material in the surgical site

• showering of a patient before surgery

• Usage of Surgical drains

Major surgical site infections :

When the wound discharges a significant amount of pus or when there is a need for secondary procedure for the drainage it is called major surgical site infection.

Clinical signs such as tachycardia, pyrexia, and raised leucocyte count are seen. Hospital stay is prolonged in such patients.

Minor wound infection :

These typeof infection discharges infected serous fluid . But the patient does not have severe discomfort or require prolonged hospital stay or does not have systemic signs.

Wound infection grading:

1.Southampton scoring system.

2. The ASEPSIS wound score.

Southampton scoring system

Grade	Appearance
0	Normal healing
I Normal healing with mild bruising or erythema:	
A	Some bruising
B	Considerable bruising
C	Mild erythema
II Erythema plus other signs of inflammation:	
A	At one point
B	Around sutures
C	Along wound
D	Around wound
III Clear or haemoserous discharge:	
A	At one point only (<2cm)
B	Along wound (>2cm)
C	Large volume
D	Prolonged (>3 days)
Major complication IV Pus:	
A	At one point only (<2cm)
B	Along wound (>2cm)
V Deep or severe wound infection with or without tissue breakdown; haematoma requiring aspiration	

The wound grading system used was simplified for the use of analysis.
By using the worst wound score recorded and information about any treatment instituted either in hospital or the community, wounds were regarded in four categories:
(A) normal healing;
(B) minor complication;
(C) wound infection-wounds graded IV or V or wounds treated with antibiotics after discharge from hospital, irrespective of the wound grading given to them by the nurse; and
(D) major haematoma-wound or scrotal haematomas requiring aspiration or evacuation.

ASEPSIS wound score

	Proportion of wound affected					
Wound characteristic	0	<20	20-39	40-59	60-79	>80
Serous exudate	0	1	2	3	4	5
Erythema	0	1	2	3	4	5
Purulent exudate	0	2	4	6	8	10
Separation of deep tissues	0	2	4	6	8	10

Points are scored for daily wound inspection.

Criterion	Points
Additional treatment:	
Antibiotics	10
Drainage of pus under local anaesthesia	5
Debridement of wound (general anaesthesia)	10
Serous discharge*	daily 0-5
Erythema*	daily 0-5
Purulent exudate*	daily 0-10
Separation of deep tissues*	daily 0-10
Isolation of bacteria	10
Stay as inpatient prolonged over 14 days	5

* Given score only on five of seven days. Highest weekly score used

Category of infection: total score 0-10 = satisfactory healing;
11-20 = disturbance of healing; 20-30 = minor wound infection;
31-40 = moderate wound infection; >40 = severe wound infection.

Types of localized infection :

Abscess :

An abscess is collection of pus and it presents with all features of inflammation .

Along with signs of inflammation there will be loss of function .

If it hurts, the part is not used by the patient.

It can be metastatic following bacteraemia.

Predominantly, staphylococcus aureus causes tissue necrosis and suppuration.

Pus composed of dead white cells which releases oxygen free radicals , cytokines and other substances.

Granulation tissue contains macrophages, angiogenesis and fibroblasts which forms around suppurative process and collagen gets deposited.

Abscess is surrounded by inflammatory response containing inflammatory cells, fibrinous exudates and odema.

If antibiotic is taken after abscess formation antibioma occurs.

If the abscess is not reabsorbed completely or if it is not drained then it results in chronic abscess.

Abscess tend to spread along the plane of least resistance and may point towards skin.

It may rupture on its own or may need surgical intervention to drain it.

Abscess contain hyperosmolar material which draw in fluid which increases pressure and causes pain.

Abscess at surgical site occurs usually takes 7 – 10 days of surgery in SSI.

Abscess cavity has to be cleaned after incision and drainage.

Once the cavity is left open to drain freely antibiotic is not needed and it is only needed when the cavity is closed after incision and drainage.

When a pilonidal abscess is drained and closed, the recurrence rate is high as nidus of hair may remain in the subcutaneous plane near the abscess.

Small breast abscess can be treated by ultrasound guided aspiration.

Chronic abscess lead to fistula and sinus formation.

It contain lymphocytes and plasma cells.

There is tissue sequestration followed by calcification.

Organisms associated with chronic abscess are mycobacterium and actinomyces.

In abdomen anastomotic leak is main cause of abscess formation.

Abscess in the deep cavity can be found by ultrasound, CT, MRI and are useful for guided aspiration and avoiding surgical intervention.

Cellulitis :

It is the non suppurative invasive infection of the tissues.

There is poor localization .

Spreading infection usually caused by β – haemolytic streptococci, staphylococci and clostridium perfringes.

They release proteases which causes tissue destruction , gangrene and ulceration.

By the release of toxins, cytokine mediated systemic inflammatory response is stimulated which produces fever, chills and rigor.

Blood culture is negative.

Lymphangitis :

Painful red streaks is seen in the affected lymphangitis.

The lymph nodes draining the affected area are also painful.

Systemic inflammatory response syndrome :

It can be caused by multiple trauma , burns and pancreatitis without infection.

It is a systemic manifestation of sepsis.

Toxins stimulate the macrophages to release cytokines.

Interleukin – I and tumour necrosis factor alpha are the proinflammatory cytokines released in SIRS.

Septic manifestation and multi organ dysfunction syndrome in SIRS are mediated through cytokines.

Cytokine stimulate neutrophils to adhere to the vessel wall by chemostasis.

The activated neutrophils release lysosomalenzymes , oxidants and free radicals which kill the invading bacteria and damage the adjacent cells also.

Coagulation, complement and fibrinolytic pathways are stimulated normally in inflammatory process.

In presence of severe sepsis and bacteraemia this response may be harmful to the host as it occurs in excess which is known as SIRS.

The high circulating levels of circulating cytokines and activated neutrophils causes fever, tachycardia and tachypnoea.

The activated neutrophils adhere to the vascular endothelium away from the site of infection to the key organ and causes increased permeability .

This causes cell damage in that organ and it become dysfunctional and gives raise to multi organ dysfunction syndrome.

If it is not controlled it progress to multiple system organ failure.

Respiratory, renal, cardiac, liver, intestinal and circulatory failure occurs along with shock. At this stage host resistance to infection is reduced and it leads to death.

Systemic inflammatory response syndrome should have two of the following:

Hyperthermia (> 38° C) or hypothermia (< 36° C)

Tachycardia (> 90 / min, no β – blockers)

tachypnoea (> 20 / min).

White cell count > 12000 or < 4000

Sepsis is SIRS along with documented infection.

Sepsis syndrome or severe sepsis :

Sepsis along with one or more organ failure.

Bacteraemia :

Bacteraemia is common in anastomotic breakdown (deep space infection)

It may follow procedures undertaken in infected tissue like instrumentation in infected bile and urine.

It may occur when colonization occur in indwelling catheter.

After anastomotic break sepsis and multiorgan dysfunction occurs.

It is mainly caused by gram negative bacteria.

Sepsis is common after the anastomotic leak.

Bacteraemia is dangerous for patients with the prosthesis.

Surgical wound infections increases healthcare cost.

It increases duration of hospital stay.

It increases morbidity.

Prophylactic antibiotic was found to reduce the risk of infection.

SURGICAL WOUND INFECTIONS :

It is identified by

- Redness
- Warmth
- Swab culture positive from the discharge
- Purulent discharge

Even with sterile technique and potent antibiotics surgical site infections occur in 2-9 % of all surgical procedures.

Bacteria are found in 90% of all surgical incisions despite all aseptic precautions.[9]

Wound Class

1) Clean cases.
2) Clean contaminated cases.
3) Contaminated cases.
4) Dirty cases.

CLEAN CASES :

1) surgical site infection is < 2% in clean cases.
2) Elective cases like

   Hernia, thyroid , breast, craniotomy, cardiothoracic surgeries etc.

3) There is no acute inflammation.
4) There is no transection of the gastrointestinal,genitourinary, oropharyngeal, biliary or tracheobronchial tracts.
5) There will be no break in aseptic technique
6) Antibiotic use is controversial

CLEAN CONTAMINATED :

1) surgical site infection is 2-10% in clean contaminated cases.
2) Urgent or emergency cases.
3) Controlled opening of the gastrointestinal,genitourinary,oropharyngeal ,biliary and tracheobronchial tracts.
4) There will be minimal spillage
5) There will be minor break in aseptic precautions
6) Antibiotics used for prophylaxis.

CONTAMINATED :

surgical wound site infection is 10-20%

the operating field is grossly soiled.

Examples are :

Patients undergoing surgery of colon and rectum with spillage and contamination.

Surgeries involving biliary system with infected bile.

Genitourinary tract surgery in presence of urine.

Antibiotics used for prophylaxis.

DIRTY :

Surgical wound site infection is >30%

Emergency surgery with perforation of gastro intestinal, oropharyngeal, biliary, tracheobronchial tracts.

Surgeries of Penetrating trauma lasting> 4 hours.

Examples of dirty cases include appendicular perforation with appendicular abscess

formation.

WOUND CLASS	EXAMPLE OF CASES	EXPECTED INFECTION RATES
CLEAN (CLASS I)	HERNIA REPAIR, BREAST BIOPSY	1.0 – 5.4 %
CLEAN/CONTAMINATED (CLASS II)	CHOLECYSTECTOMY, ELECTIVE GI SURGERY	2.1 – 9.5 %
CONTAMINATED (CLASS III)	PENETRATING ABDOMINAL TRAUMA, LARGE TISSUE INJURY, ENTEROTOMY DURING BOWEL OBSTRUCTION	3.4 – 13.2 %
DIRTY (CLASS IV)	PERFORATED DIVERTICULITIS, NECROTIZING SOFT TISSUE INFECTIONS	3.1 – 12.8%

Surgical wound infection depends on numerous factors.

It may be specific to the patient or the procedure.

PATIENT AND OPERATION CHARACTERISTICS THAT MAY INFLUENCE THE RISK OF SURGICAL SITE INFECTION DEVELOPMENT

Patient	Operation
Age	Duration of surgical scrub
Nutritional status	Skin antisepsis
Diabetes	Preoperative shaving
Smoking	Preoperative skin prep
Obesity	Duration of operation
Coexistent infections at a remote body site	Antimicrobial prophylaxis
Colonization with microorganisms	Operating room ventilation
Altered immune response	Inadequate sterilization of instruments
Length of preoperative stay	Foreign material in the surgical site
	Surgical drains
	Surgical technique
	Poor hemostasis
	Failure to obliterate dead space
	Tissue trauma

ASA(American society of anesthesiologists) - physical status 3,4 & 5

ASA risk factors :

ASA PHYSICAL STATUS CLASSIFICATION

ASA physical status	I	II	III	IV	V	VI
Definition	"Healthy"	"Mild systemic disease"	"Severe systemic disease but not incapacitating"	"Incapacitating disease"	"Dying"	"Declared brain death"
Age	> 3 months to < 65 years	≤ 3 months or ≥ 65 to 84 years	≤ 1 month preterm NB or ≥ 85 years			
Functional capacity; walk up 1 flight of stair or 200 m. on the level	Complete without distress	Rest at completion because of distress	Stop en route because of distress	Unable to do		
Medical status	No organic, physiologic, or psychiatric disturbance	Single/multiple systemic disease(s) with good control No functional limitations or vital organ involvement	Poorly controlled systemic disease(s) Some functional limitations No immediate life threatening condition	Poorly controlled systemic disease(s) Significant functional limitation Constant potential threat to life	End stage disease(s) and not expected to survive within 24 hours	Clinically dead patients awaiting organ harvest
Mortality rate (%)	0.06 – 0.08	0.27 – 0.4	1.8 – 4.3	7.8 – 23	9.4 – 51	
Emergency status	In addition to indicating ASA physical status, any patient undergoing an emergency operation is indicated by the suffix "E", e.g., ASA III E					

Prevention of surgical site infection through surgical techniques :

By maintaining sterile field.

By ensuring haemostasis to reduce the risk of haematoma

By employing proper reconstructive technique to minimize tension on wound edges and adequate blood supply.

Post operative wound infection is due to the predominant micro organism in that area.

The choice of antibiotic should be directed covering that organism.

Culture from the discharge can guide to select on the antibiotics.

Intraincisionalantibiotic :

These antibiotics were administered in conjunction with local anaesthsia as a single dose before the surgery.

Nafcillin and clindamycin were studied and found to reduce the wound infections.

Intraincisional antibiotics were found to be :

Inexpensive

Easy to administer

Well tolerated by the patient.

Determinants of surgical site infections :

$$\frac{\text{Dose of bacterial contamination} * \text{virulence}}{\textit{resistance of the host patient}} = \text{Risk of SSI}$$

If the contamination of microorganisms are increased the risk of surgical site infection also increases.

Preoperative planning to reduce surgical site infection :

The patient should take bath before surgery.

The patient is advised to scrub the surgical site with antiseptic solution/soap.

The incision site should be cleaned by shaving/epilation.

There is a need regarding postponement of surgery in case when the surgeons arm or hand is infected or when there is any remote infection in the patient.

Prevention of surgical site infection in the operating room :

The use of antiseptic solutions for skin preparations, double gloving, drapes, use of caps, sterile gowns, masks and reducing the personnel is always considered[(10)].

Intra operative strategies :

Handling soft tissue gently to avoid crushing.

Crushing causesdevitalization of tissues.

Using electro cautery sparingly to control bleeding.

Electro cautery leaves behind dead tissue which is likely to get infected.

Achieving haemostasis at the surgical site.

Avoiding overuseof braided silk unnecessarily.

Removing dead tissue and foreign body.

Keeping the operating time as short as possible.

Avoiding a dead space within the surgical wound site.

Using closed suction drain through separate stab incision.

Drains help to prevent tissue fluid being accumulated in the dependent part of the wound.

Delaying primary closure for the wound that are severely contaminated and dirty.

By following these technical details the surgical site infection can be brought to a minimum.

Post operative prevention of surgical site infection :

Changing the dressing after 24 to 48 hours and promptly discharging the patient will reduce surgical site infection.

Enhancement of host defences :

Three new strategies.

Increased oxygen delivery :

Evidences exist regarding increased oxygen delivery and prevention of infection. Experimental trials have also demonstrated the clinical value of

administering supplemental oxygen.

Optimizing body core temperature :

Better intra operative and post operative management of temperature may reduce surgical site infection.

Glycaemic status:

Hyperglycemia contributes to surgical site infection and hence a better control of sugar level helps to prevent surgical site infection.

Economic impact of surgical site infections :

Surgical site infections impose a heavy cost on the patient as well as on the health care.

Prolongation of stay and extra charges were attributed to nosocomial infections.

Prophylactic antibiotics:

Prophylactic antibiotic should target the anticipated organisms.

Contaminated ,dirty and complicated procedure should receive additional post operative coverage.

Antibiotic prophylaxis should be administered after every 3 hours for prolonged procedure.

Prophylactic antibiotic should be administered 2 hours before the skin incision.

Administering parental antibiotic before the skin incision ensures that adequate serum and tissue antimicrobial level are present at the time of contamination.

Common sources of infection :

Surgical wards, wounds, ulcers, drains, catheters, urine, sputum, urine, faeces& open wounds.

Operation room without proper sterilization of instruments, proper ventilation and proper operating techniques.

Organisms causing surgical site infection :

Commonly staphylococcus aureus.

Colonization refers to presence of bacteria without signs and symptoms of systemic inflammation.

Transient exposure of a wound to bacteria is called contamination.

Sequence of events in surgical wound :

Activation of inflammation occurs by cut, incision, abrasion and burn.

Protein coagulation, mast cell activity, platelet aggregation, release of complements and bradykinin.

Phase I of inflammation begin with vasodilatation and increased vascularity.

Phase II inflammation proceeds with phagocytic infiltration, bacterial phagocytosis, release of proinflammatory cytokines.

Monocytes activate and produce myofibrocytes and collagen and thus regulate wound healing.

If bacterial contamination is not controlled,proinflammatory cells release TNF α to stimulate neutrophils for phagocytosis.

It also releases reactive oxygen and acid hydrolases and interleukins thereby evoking acute inflammatory response with the formation of pus.

Pus contains necrotic tissue, neutrophils, bacteria and proteinaceous fluid.

Factors related to surgical site infection :

Bacterial inoculation occurs through instruments, surgeons, air in operating room, theatre staff, patient's endogenous bacteria like perineum, urine etc.

When there is alteration in host defences, natural and acquired, surgical site infection occurs.

Bacterial virulence plays a vital role.

Microenvironment in the wound like haemoglobin at wound site and presence of necrosis which interferes with phagocytosis.

Risk classification and identification system :

It is based on three variables

1) Microbial contamination at the surgical site

2) Duration of operation

3) Host susceptibility.

The national nosocomial infections surveillance system is basic SSI risk index :

NNIS POINT

Operation classified as contaminated or dirty	1
Patient having ASA score of 3,4& 5	1
Duration exceeds 75th percentile of 'T' point	1

Classification of wound infection according to the etiology :

Primary infection :In these infection the wound is the primary one.

Secondaryinfection :It follows a complication which is not related to the wound.

Classification of wound infections according to the time :

Early infection : within 30 days

Intermediate infection : 1 – 3 months

Late infection :> 3 months

Classification of wound infection based on severity :

minor wound infection : discharge without systemic illness

major wound infection : discharge of puswith systemic illness.

Prevention of SSI :

Preoperative skin wash with chlorhexidine decreases bacterial colonization by 80 %.

Clean wound infection after shaving is 2.3 %.

Clean wound infection after clipping is 0.9 %.

Clean wound infection without shaving or clipping is 0.9%.

Prolonged preoperative admission should be avoided for an elective case.

Preventive antibiotic therapy :

It is used when the patient has a high NNIS risk index.

It is used when there is possibility of high risk of infection with the procedure.

Postoperative systemic antibiotic after 24 hours had not shown to reduce surgical site infection.

Proper techniques and wound microenvironment is more important than the antibiotic.

Enhancement of host defences :

Optimising body temperature is important as warmer patient resist bacteria better.

Increased oxygen delivery helps in phagocytic eradication of microbes.

Blood glucose level is important even for non diabetic patients.

Management of surgical site infections :

Debridement : All infected material and pus should be removed from the wound site.

Sutures should be removed for free drainage of infected material.

Infected fluid is sent for culture and sensitivity and appropriate antibiotic should be started.

Infected wound, after showing health granulation tissue, secondary suturing is done or often allowed to heal by scarring.

Gas gangrene :

This is caused by Clostridium perfringes.

They are anaerobic, gram positive spore bearing bacilli found in faeces and soil.

They occur in military , traumatic surgery and colorectal operations.

Patients with diabetics, immune compromised and malignancy are at higher risk when they have a foreign body or necrotic tissue which favours ananaerobic environment.

Military wound has the ideal environment for anaerobic infections as high velocity missiles cause excessive tissue damage.

The cavity that the wound created would have cloth and soil driven in by the missile along with devascularised tissue.

The wound discharges thin, sweet smelling brown liquid .

Gram staining of that fluid will show bacteria.

Odema and gangrene spreads following the release of hyaluronidase , collagenase , proteases and alpha toxin.

It is followed by systemic complications , circulatory collapse and multi system organ failure.

When amputation has to be performed for peripheral vascular disease prophylactic antibiotic has to be given.

Synergistic spreading gangrene(synonym : subdermal gangrene , necrotizing fasciitis) **:**

It is caused by Clostridia , Coliforms , Bacteroides species , Staphylococci , Peptostreptococci and anaerobic Streptococci.

Scrotal infection is known as Fournier's gangrene and abdominal infection as Meleney's synergistic hospital gangrene.

Patients are almostalways immunocompromised.

Severe wound pain, smell and spreading inflammation are signs of spreading infection.

The subdermal spread of gangrene is always much more extensive thanthat which appears on initial examination.

Debriment should be extensive and wound is laid open and later covered with split skin grafting.

Treatment of surgical infection :

Cellulitis around the wound take 3 – 4 days to develop.

Suppurative wound infection take 7 – 10 days to develop.

Patient with cellulitis and spreading infection needed to be treated by appropriate antibiotic.

Initially empirical antibiotic is started and later changed to specific antibiotic based on culture and sensitivity report.

Change of antibiotic before the specified duration of the course of antibiotic, or use of more than one antibiotic such as empirical treatment causes resistanceof the bacteria and complication like C.difficle enteritis.

If the wound has become infected and pus has formed, sutures have to be removed and pus has to be let out to drain freely.

If the wound has become severely infected, then wound is left open to granulate.

Since day care surgeries are done, many surgical site infections go unnoticed.

A fresh sample of pus has to be taken and sent in a transport medium with adequate quantity so the microbiologist can provide information for appropriate antibiotic .

If results are negative and bacteraemia is suspected then blood culture can be sent.

A rapid report can be obtained by gram staining.

Aerobic and aerobic culture and sensitivity done by disc diffusion method.

Minimal inhibitory concentration for anantibiotic , endotoxins and cytokine levels are measured.

Polymeric films are used as incisional drapes and to cover suture wounds.

Dressings are available to help in debriding open infected wound , absorb excessive exudates , encourage epithelialisation and formation of granulation tissue.

They also contribute to antibacterial environment around the wound.

The use of topical antibiotic has to avoided as it may cause allergy and resistance.

Topical antibiotic prevents epithelial ingrowth so it should be used in superficial wound only.

Surgical dressings :

1) **Debriding agents** :

Benoxyl,Variclene,Aserbine, – benzoic acid

Used in necrotic sloughing wound

It provides acidic environment

It improves healing by debridement action

2) **Enzymatic agents :**

Varidase – streptokinase / streptodornase

Activate fibrinolysis and liquefy pus in chronic wound ulcer

3) **Bead dressings** :

debrisan

iodosorb

By capillary action it helps to remove the micro organism.

4) **Polymeric films** :

Opsite

Biocclusive

Tegaderm

Adhesive dressing which are transparent and are suitable for sutured wound.

5) **Foams** :

Sialistic

Lyofoam

Allevyn

Elastomeric dressing can fit deep cavity wound.

6) **Hydrogels :**

Geliperm

Intrasite

Maintain moist environment and absorb moisture and it is semipermeable and allows diffusion of air.

7) **Hydrocolloids** :

Comfeel

Granuflex

Complete occlusion without exchange of gases .

It provides moist environment , promotes epithelialisation and granulation tissue.

8) **Fibrous polymers** :

Kaltostat

Sorbsan

Absorptive alginate dressing.

Used to pack deep cavity wounds.

9) Biological membranes :

Porcine skin

Amnion

Used for superficial chronic skin ulcers.

10) <u>Tulles :</u>

Non adherent paraffin impregnation

Absorptive dressing used to absorb exudates.

Prophylactic antibiotics :

They are given to prevent infection after surgery or instrumentation.

The concentration of the antibiotic at the tissue level reaches optimal level when the incision is made, when the local defence mechanisms have not yet been established or contamination of the wound has not occurred.

In prolonged surgery, the antibiotic can be repeated at approximately 4 hour intervals during surgery.

During that period the tissue level concentration would have been low.

The choice of antibiotic should cover the expected spectrum of organisms.

Patient with known heart valve disease or orthopaedic implant should receive prophylactic antibiotic during dental , urological and open viscus surgery.

Prophylactic regimens :

1) **Oesophagogastric surgery :**

Organisms :

Enterobacteriaceae

Enterococci

Regimen :

One dose of second generation cephalosporin and metronidazole in severe contamination.

2) **Biliary surgery :**

Organisms :

Enterobacteriaceae, mainly Escherichia coli.

Enterococci, mainly Streptococcus faecalis

Regimen :

One dose of a second generation cephalosporin

3) Small bowel surgery :

Organisms :

Enterobacteriaceae

Anaerobes mainly bacteroides

Regimen :

One dose of a second generation cephalosporin with or without metronidazole.

4) Appendicectomy :

Organisms :

Enterobactaeriaceae

Anaerobes mainly bacteroides.

Regimen :

One dose ofa second generation cephalosporin or gentamicin with metronidazole.

5) Colorectal surgery :

Organisms :

Enterobacteriaceae

Anaerobes mainly bacteroides

Regimen :

One dose of a second generation cephalosporin or gentamicin with metronidazole

Antiseptics used in general surgery practice :

1.Chlorhexidine :

Alcoholic 0.5 %

Aqueous 4 %

Uses :

Skin preparation

Surgical scrub in dilute solutions in open wounds

Effective against gram positive organisms.

2.Povidone – iodine (betadine) :

Alcoholic 10 %

Aqueous 7.5 %

Uses :

Skin preparations.

Surgical scrub in dilute solutions in open wound.

Safe , broad spectrum , fast acting and sporadicidal.

3.Cetrimide : (**savlon**)

Aqueous

Uses :

Hand washing

Instrument and surface cleaning

Surface active agent.

4.Alcohols :

70 % ethyl, isopropyl

Uses :

Skin preparation.

Disinfectants

5.Hypochlorites :

Aqueous preparations (Eusol , Milton , chloramines T)

Instrument and surface cleaning

Toxic to tissues

6.Hexachlorophene :

Aqueous bisphenol

Skin preparation.

Hand washing

Effective against gram negative organisms.

7.Scrubing and skin preparation :

Application of alcoholic antiseptic to skin reduces bacterial count by 95 %.

Aqueous antiseptics used for hand washing and scrub should include nails.

Maintainence of theatre discipline will reduce infection rate.

The number of staff in the theatre should be kept to the minimum.

The people moving in and out of the theatre should be kept to the minimum.

Careful monitoring of theatre ventilation and instrument sterilization would reduce infectious rate.

Gentle manipulation , dissection of tissues and limited using of diathermy will reduce the infectious rate.

Dead space and haematoma formation has to be avoided.

The avoidance of perioperative hypothermia and supplemental oxygen during recovery will reduce surgical site infection.

Post operative care of wounds :

Secondary surgical site infections i.e exogenous SSI and hospital acquired infection are due to poor hospital standards.

MRSA is an indicator for poor post operative wound care management.

Careful audit should be conducted and there should be change in practice to reduce infectious rate.

The contamination is measured by sample tissue at the end of operation from the wound edge.

The contamination is related to the infectious rate.

For clean cases the infectious rate before the prophylaxis is 1- 2 % and after the prophylaxis is 1-2 %.

For clean contaminated cases the infectious rate before prophylaxis is 20 – 30 % and after prophylaxis is < 10 %

For contaminated cases the infectious rate before the prophylaxis is upto 60 % and after prophylaxis is 15 – 20 %.

For dirty cases the infectious rate before prophylaxis is upto 60 % or more and after prophylaxis is < 40 %.

Bacteria involved in surgical infection :

Streptococci :

Streptococci are gram positive cocci.

They form chains.

The β – haemolytic Streptococci is an important bacteria causing surgical infection.

It resides in the pharynx.

Group A Streptococci also known as Streptococcus pyogenes which release enzymes such as streptolysin , streptokinase and streptodornase and has the ability to spread cause cellulitis and causes tissue damage.

Streptococci faecalis is an enterococcus.

Streptococci pyogenes and Streptococci faecalis are both associated with wound infection after large bowel surgery.

They are sensitive to penicillin and erythromycin.

Cephalosporins are an alternative to penicillin.

Staphylococci :

It is a gram positive bacteria .

It form clumps.

It causes exogenous suppuration i.e pus formation in wounds.

Methicillin resistant staphylococcus aureus can cause epidemics.

Vancomycin resistant strains have also emerged.

Patients found MRSA positive were denied access to hospital.

Swapping, isolation of patients , ward to be closed and disinfection of ward are considered.

The infection caused by staphylococcus aureus is localized and suppurative.

Most staphylococcus produces β lactamase and are resistant to penicillin but are sensitive to Vancomycin, Flucloxacillin, Aminoglycosides, some Cephalosporins and Fusidic acid.

The newer antibiotics are effective against resistant strains.

Linezolid – good oral activity

Tigecycline – wide spectrum

Daptomycin – good activity in bacteraemia

The newer antibiotics are expensive and have bone marrow suppression , renal toxicity and hepatic toxicity.

Clostridia :

They are gram positive obligate anaerobic bacteria.

They produce spores.

Clostridium perfringes causes gas gangrene.

Clostridium tetani causes tetanus.

Clostridium difficile causes pseudomembranous colitis.

It also causes hospital acquired infections.

Pseudomembranous colitis is caused by overuse of antibiotics particularly in elderly and immunocompromised people.

It is also caused due to poor hygiene.

Patient will have bloody diarrhoea and may present with perforation and needs resection and treatment with antibiotics like Vancomycin and Metronidazole.

Identification of toxin is an early diagnostic test.

Aerobic gram negative bacteria :

They are normal inhabitants of the large bowel.

E.coli , Proteus and Klebsiella species acting in synergy with bacteroides cause surgical site infection.

E.coli is the major cause of urinary tract infection particularly in relation to catheterization.

Pseudomonas species tend to colonise burns ,tracheastomy wounds and urinary tract.

Carbapenems (meropenem) are used in severe infections.

Bacteroides :

They are strict anaerobes .

They colonize large bowel , vagina and oropharynx.

They act in synergy to cause surgical site infection.

Principles of antimicrobial treatment :

Only spreading infection and patient having systemic infection justify using systemic antibiotic.

Whenever possible, culture and sensitivity has to be obtained for appropriate treatment.

Until the culture and sensitivity report comes it is better to start antibiotic empirically.

If there is no improvement in the condition of the patient, then there is chance of missing a precise diagnosis.

Use of antibiotic is indicated in spreading infection , systemic illness like systemic inflammatory response syndrome or multi organ dysfunction syndrome.

The appropriate treatment of localized surgical site infection is interventional radiological drainage of pus or open drainage and debridement.

Antibiotics used in treatment and prophylaxis of surgical infection :

Antimicrobials are produced by living organisms (antibiotic) or can be synthesized.

They can kill the bacteria or prevent its growth

Penicillins act on bacterial cell wall.

Aminoglycosides act at ribosomal level preventing the production of proteins required to maintain the integrity of the cell wall.

Penicillin :

Benzylpenicillin is effective against gram positive pathogens.

Actinomyces which causes chronic wound infection is sensitive to penicillin.

Gas gangrene need high dose of intravenous benzylpenicillin.

Flucloxacillin:

It is a β lactamase resistant penicillin.

It is used in community acquired staphylococcal infections.

Ampicillin and amoxicillin :

These are β – lactam penicillins

It is available for oral and parental use.

It is effective against Enterobacteriaceae, Enterococcusfaecalis and majority of group D Streptococci.

Mezlocillin and azlocillin :

These are Ureidopenicillins.

They are active against Enterobacter ,Klebsiella&Bacteroides.

They are susceptible to β – lactamases.

Clavulanic acid is available in combination with Amoxicillin.

Clavulanic acid protects amoxicillin from the β – lactamases.

It is used in localized cellulitis , superficial staphylococcal infections, infected animal and human bite.

Cephalosporins :

Cefuroxime ,Cefotaxime are effective against intra abdominal skin and soft tissue infections.

Cephalosporins may be combined with an Aminoglycoside and an Imidazole for anaerobic coverage.

Aminoglycosides :

It is active against gram negative enterobacteriaceae.

It causes ototoxicity and nephrotoxicity following high doses.

It has marked post antibiotic effect.

Vancomycin :

It is a glycopeptide.

It is effective against gram positive bacteria.

It is used in MRSA cases and pseudomembranous colitis.

It may produce ototoxicity and nephrotoxicity.

Imidazoles :

Metronidazole is most widely used imidazole.

It is active against anaerobic bacteria.

Used in surgeries handling bowel both as therapeutic and prophylactic antibiotic.

Carbapenems :

They are active against gram positive bacteria.

It has broad spectrum anaerobic action.

Meropenem ,Ertapenem and Imipenem are members of Carbapenems.

It is used in serious mixed abdominal infections (peritonitis).

Quinolones :

It is active against wide spectrum of organisms.

Surgical site infection -

Among the nosocomial infections surgical site infection accounts for about 38%.Of the surgical site infections, organ or spaces which were accessed during surgery are involved in one third, and two thirds were confined to incision made during the operation.

Surveillance data regarding surgical site infection indicate that the laparoscopic surgeries have lower incidence of surgical site infection than the open surgeries.

AIM OF THE STUDY

1. Incidence of abdominal surgical site infection.
2. Risk factors for abdominal surgical site infection.
3. To study most common organism encountered and their sensitivity to antibiotics.

MATERIALS AND METHODS

Period of Study

- Data was collected prospectively from DECEMBER 2013 to SEPTEMBER 2014

Place of Study

- Government Kilpauk Medical College Hospital and Government Royapettah Hospital.

INCLUSION CRITERIA

1. Only those patients who have undergone elective abdominal surgeries in Govt. Kilpauk Hospital and Govt. Royapettah Hospital were included.
2. Age of the patient more than 12 years.
3. Patients presenting with following signs at the surgical site
    - Erythema
    - Induration
    - Discharge—serous/purulent
    - Wound gaping

SSI-ERYTHEMA

SSI- WOUND GAPING

EXCLUSION CRITERIA

1. Patients who undergo emergency abdominal surgery.

2. Age less than 12 years.

3. HIV positive state and patients on steroid

SIZE OF THE STUDY – 150 patients

TYPE OF STUDY: - prospective observational study .

SOURCE OF DATA: The source of data for my study were the patients who underwent abdominal surgeries in the Department of General Surgery at Govt. Kilpauk Medical College Hospital and Govt. Royapettah Hospital.

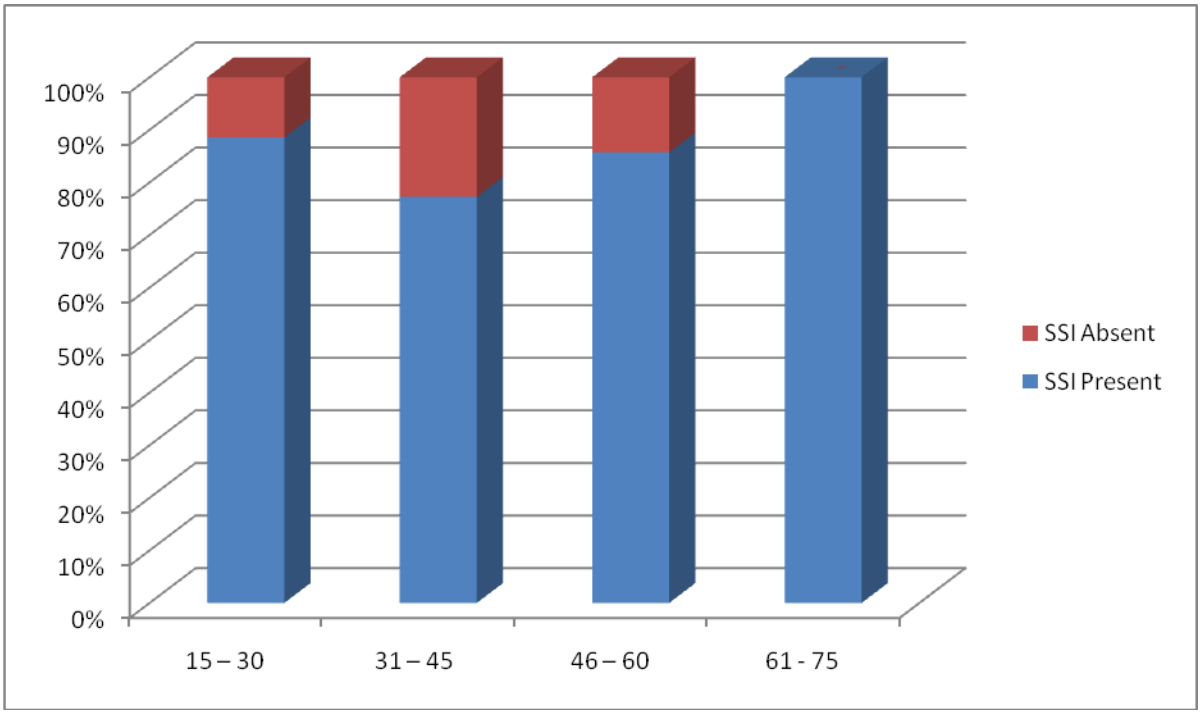
In my study, I took into account ,the pre operative risk factors such as obesity, hypertension,diabetes and intra operative risk factors duration of surgery, diathermy usage of the patient and post operatively, I looked into signs of wound infection . I sent discharges for culture and sensitivityand startedappropriate antibiotics.

OBSERVATION AND RESULTS

1.Incidence of SSI is 130/150 – 86.7 per hundred surgeries.

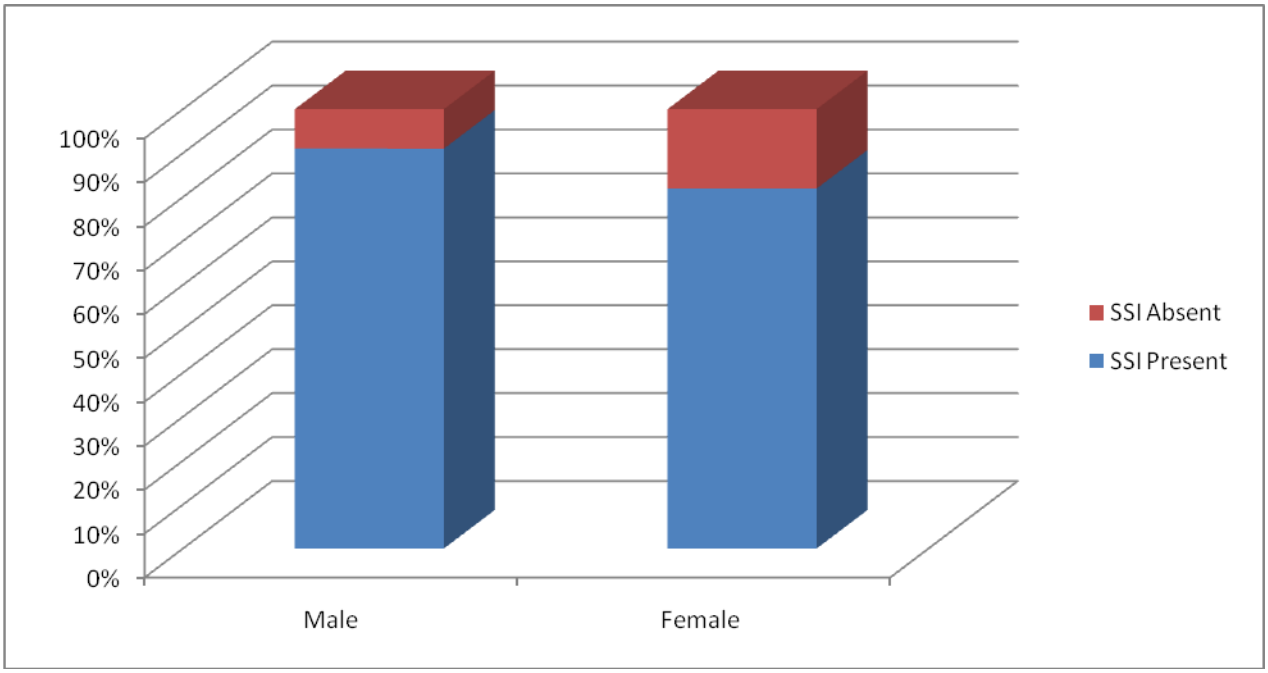
2.In my study, as the age increases the incidence of surgical site infection increases (p value<0.05)

Age group	Number	SSI		Chi square	P value
		Present	Absent		
15 – 30	35	31	4		
31 – 45	44	34	10	7.96	0.046
46 – 60	42	36	6		
61 - 75	29	29	0		



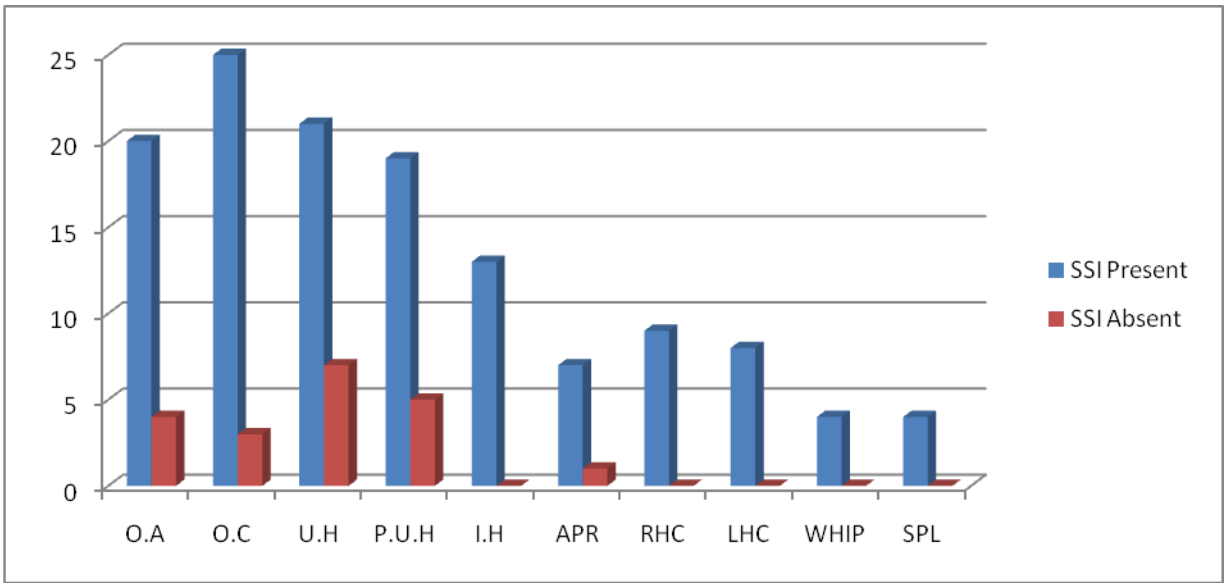
3)In my study there is no significance between sex and surgical site infection.

Sex	SSI		Chi square	P value
	Present	Absent		
Male	71	7	2.67	0.102
Female	59	13		



4.In my study , the incidence of surgical site infection is higher in patients undergoing open cholecystectomy surgery.

Surgery done	SSI	
	Present	Absent
O.A	20	4
O.C	25	3
U.H	21	7
P.U.H	19	5
I.H	13	0
APR	7	1
RHC	9	0
LHC	8	0
WHIP	4	0
SPL	4	0



5.In my study the incidence of surgical site infection was high among obese patients than others and other risk factors have no significance with surgical site infection

PRE OP RISK FACTOR	SSI		CHI SQUARE	P VALUE
	PRESENT	ABSENT		
OBESITY				
PRESENT	28	0	5.30	0.011
ABSENT	102	20		
HYPERTENSION				
PRESENT	30	6	0.46	0.336
ABSENT	100	14		
DM				
PRESENT	29	5	0.07	0.491
ABSENT	101	15		
IHD				
PRESENT	8	0	1.30	0.308
ABSENT	122	20		

6.IN MY STUDY THERE IS NO SIGNIFICANCT RELATION BETWEEN SURGICAL SITE INFECTION AND DURATION OF SURGERY.

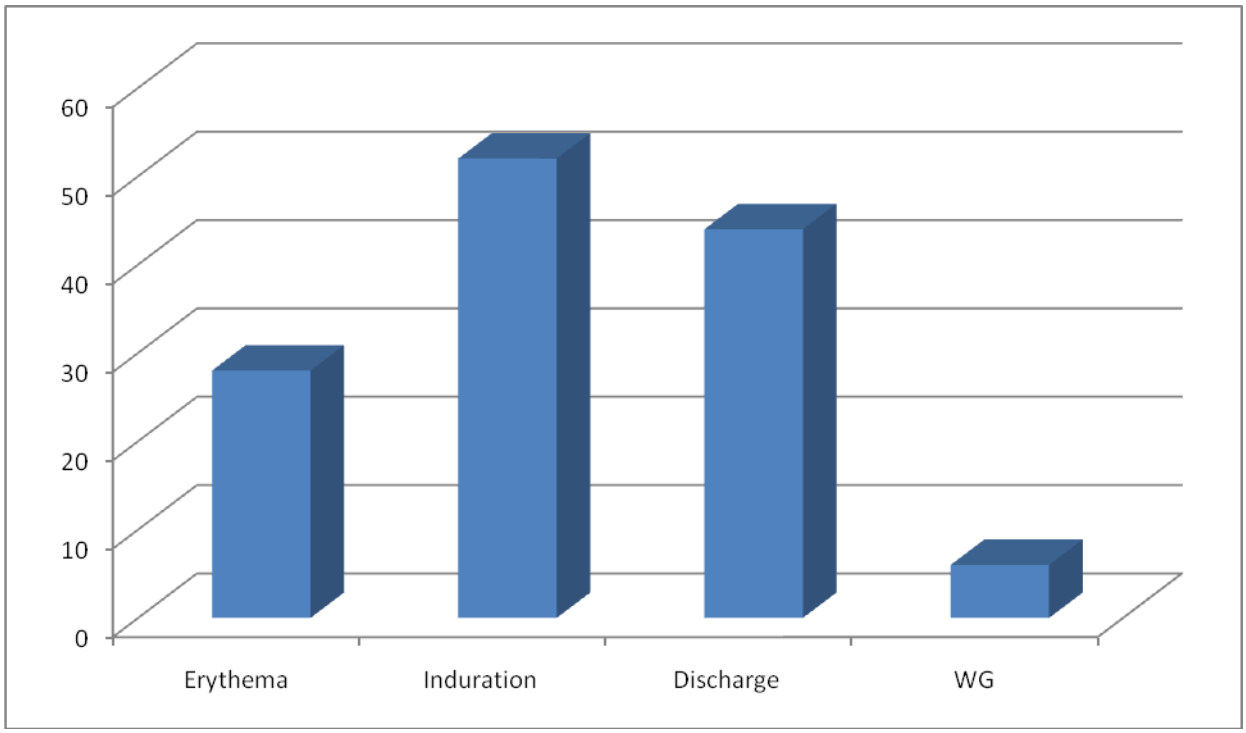
Duration of surgery	SSI		Chi square	P value
	Present	Absent		
<1 hr	39	10		
1-2 hrs	45	10		
2-3 hrs	40	0	10.32	0.035
3-4 hrs	4	0		
5	2	0		

7.In my study there is no significant relation between surgical site infection and duration of diathermy

Duration of diathermy	SSI		Chi square	P value
	Present	Absent		
<10 mins	110	18		
10-15 mins	14	0	3.16	0.206
Nil	6	2		

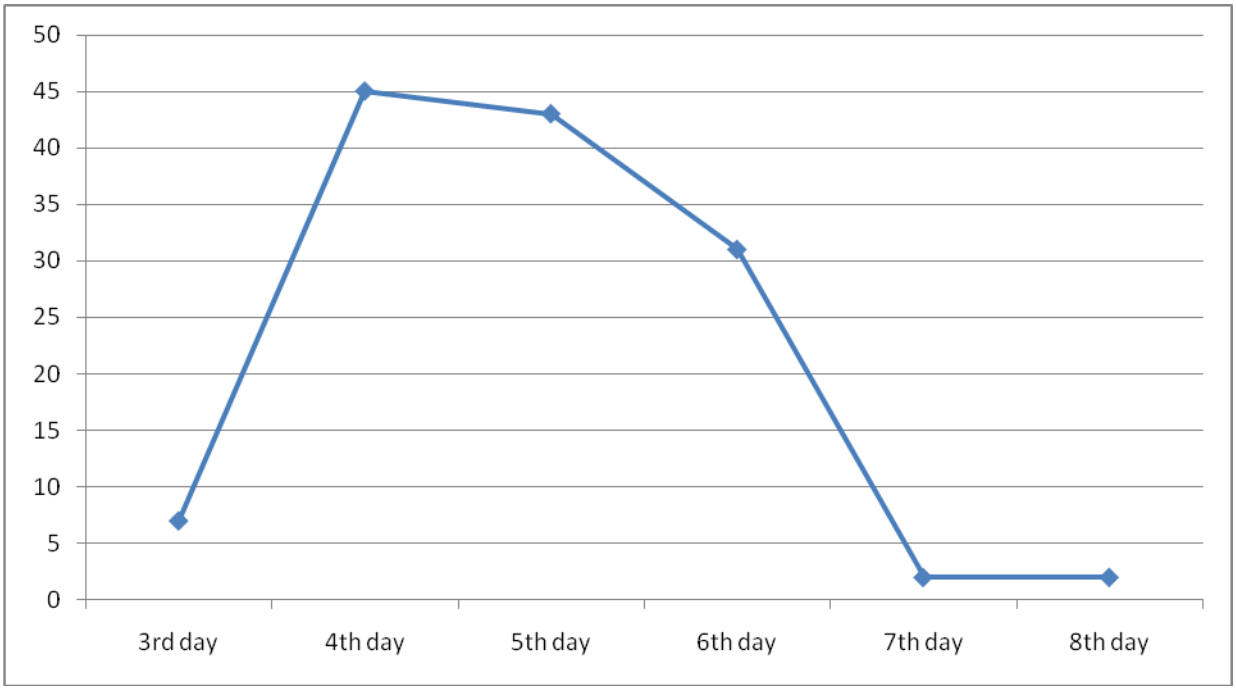
8.In my study the most frequent presentation of surgical site infection is induration

SSI presentation	Frequency	Percentage
Erythema	**28**	**21.6**
Induration	**52**	**40.0**
Discharge	**44**	**33.8**
WG	**6**	**4.6**
Total	**130**	**100**



9.In my study the frequent presentation of surgical site infection is on the fourth post operative day

Post op day of Infection	Frequency	Percentage
3rd day	7	5.4
4th day	45	34.6
5th day	43	33.1
6th day	31	23.9
7th day	2	1.5
8th day	2	1.5
Total	130	100



10.In my study the most common organism isolated from the site of infection is E.coli

Culture organism seen	Frequency (n=59)	Percentage
Staphlococcus	12	20.3
Streptococcus	9	15.3
Klebsiella	14	23.7
Proteus	13	22.0
E.coli	15	25.4
P.S	2	3.4
No	8	13.5

11.In my study the drug ciprofloxacin has more sensitivity than other drugs

Drug sensitivity	Frequency (n=59)	Percentage
Cefotaxime	10	16.9
Ceftriaxone	6	10.2
Ciprofloxacin	20	33.9
Metronidazole	11	18.6
Amikacin	11	18.6
Imipenem	8	13.5
Mero	4	6.8
P.T	2	3.4
No	9	15.3

DISCUSSION

1.SSI - INCIDENCE

--Among the 150 patients taken for my study, surgical site infection was present in 130 patients (86.7%) which is very much higher than17.4% and 16%which was noted in other studies.^(4,5).

2.SSI– SEX

--in my study ssi is not correlated with gender . this finding is similar to that in other studies andliterature (4,6)

3.SSI - AGE

-- in my study as the age increases the incidence of surgical site infection increases (p value<0.05)(4,6)

4.SSI- COMORBIDS

-- in my study the incidence of surgical site infection is high among obese patients than others and other risk factors have no significance with surgical site infection,though diabetes mellitus and hypertension are established risk factors in surgical site infection.

5.SSI - DURATION OF SURGERY

-- in my study there is no significant relation between surgical site infection and duration of surgery. but significance has been noted in other studies.^(4,7)

6.SSI-DURATION OF DIATHERMY USAGE

--in my study there is no significant relation between surgical site infection and duration of diathermyusage .

7.in my study the most frequent presentation of surgical site infection is induration.

8.In my study the most common organism isolated from the site of infection is E.coli.

9.In my study the frequent presentation of surgicalsiteinfection is on the fourth post operative day.

10.In my study the drug Ciprofloxacin has more sensitivity than other drugs.

CONCLUSION

The incidence of ssi in my study is 86.7% , which is very much higher.

Though several riskfactors have an effect on surgical site infection, my study provides a positive correlation of ssi with obesity only.

The most common organism encountered in my study is Escherichia coli and the most sensitive antibiotic is Ciprofloxacin.

Thus surgical site infection has a burden on economy of the society and its incidence should be brought down by a multimodal approach.

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PROFORMA

NAME

AGE/SEX

I.P.NO.

D.O.A

D.O.D

SURGERY DONE

POST OPERATIVE DAY

PRESENTING COMPLAINTS

1. **Pain**
2. **Swelling**
3. **Discharge**
4. **Wound Dehiscence**
5. **Fever**

- **Indication for surgery**
- **Pre operative antibiotic usage**
- **Type of surgery**
- **Duration of surgery**
- **Diathermy usage**
- **Usage of mesh.**
- **drain**

MASTER CHART

S.NO.	AGE 15-30=1 31-45=2 46-60=3 61-75=4	SEX M=1 F=2	SURGERY DONE O.A=1 APR=6 O.C=2 RHC=7 U.H=3 LHC=8 P.U.H=4 WHIP=9 I.H=5 SPL=10	PRE OP RISK FACTOR OB=1 HT=2 DM=3 IHD=4	INTRA OP RISK FACTOR DUR. OF SURG < 1 HR=1 1-2 HRS=2 2-3 HRS=3 3-4 HRS=4 > 4 HRS=5	DUR. OF DIATHERMY < 10 MINS=1 10-15 MINS=2 > 15 MINS=3 - -	S.S.I ERY=1 IND=2 DIS=3 WG=4	P.O.D S.S.I NOTED	C&S STA=1 STC=2 KLB=3 PRO=4 E.C=5 P.S=6	SENSITIVITY CEFO=1 AMIC=5 CEFT=2 IMP=6 CIPR=3 MERO=7 METR=4 P.T=8
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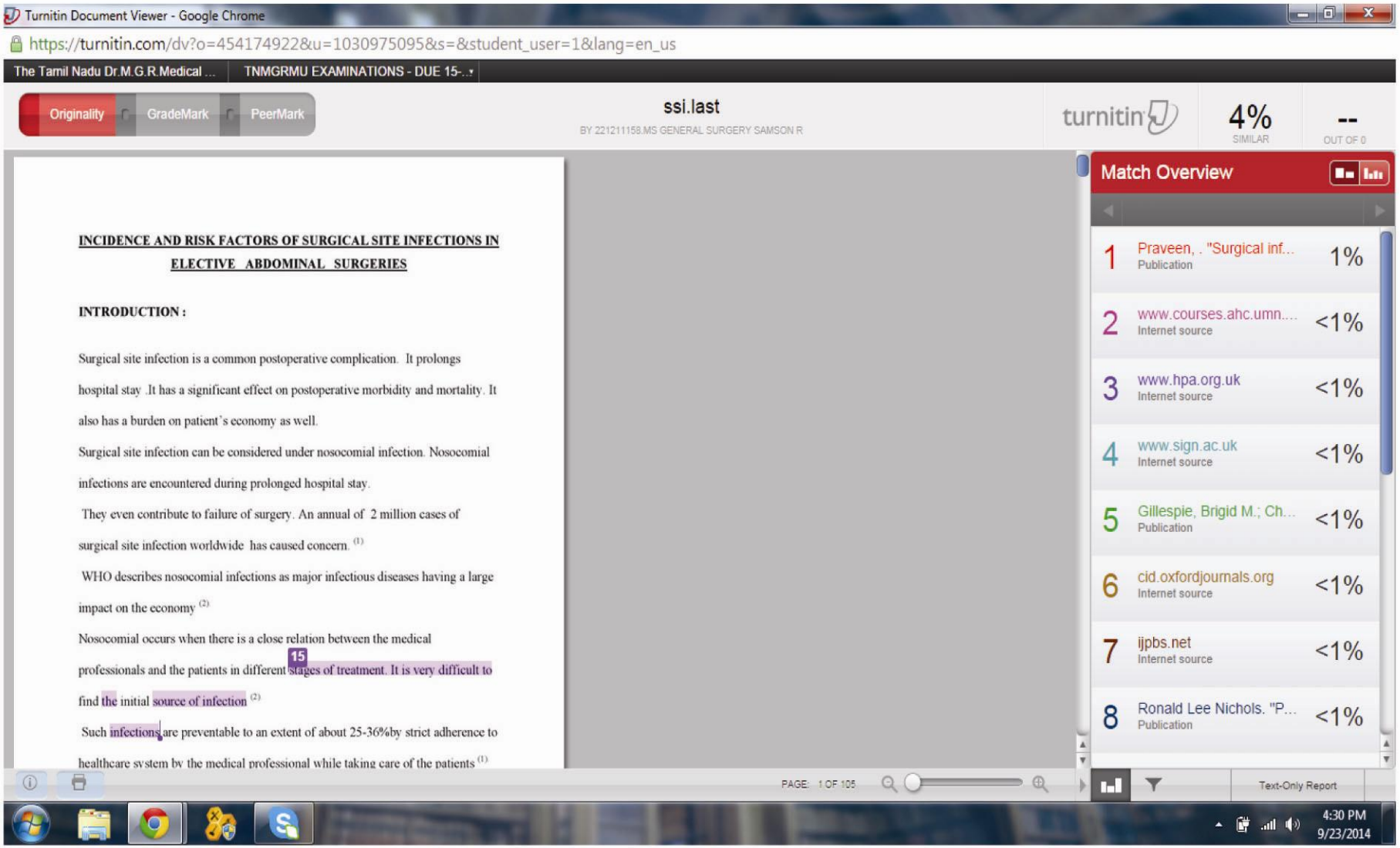
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INCIDENCE AND RISK FACTORS OF SURGICAL SITE INFECTIONS IN ELECTIVE ABDOMINAL SURGERIES
INTRODUCTION :
Surgical site infection is a common postoperative complication. It prolongs hospital stay .It has a significant effect on postoperative morbidity and mortality. It also has a burden on patient's economy as well.
Surgical site infection can be considered under nosocomial infection. Nosocomial infections are encountered during prolonged hospital stay.
They even contribute to failure of surgery. An annual of 2 million cases of surgical site infection worldwide has caused concern. (1)
WHO describes nosocomial infections as major infectious diseases having a large impact on the economy (2)
Nosocomial occurs when there is a close relation between the medical professionals and the patients in different stages of treatment. It is very difficult to find the initial source of infection (2)
Such infections are preventable to an extent of about 25-36%by strict adherence to healthcare system by the medical professional while taking care of the patients (1)
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GOVT. KILPAUK MEDICAL COLLEGE
CHENNAI-10
REF.NO.18520/ME-I/Ethics/2013 Dt:05.12.2013
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai-10 reviewed and discussed the application for approval "A Study on incidence and risk factors on surgical site infection in elective abdominal surgeries" – For Project work submitted by Dr.R.Samson, MS (General Surgery) PG Student, KMC, Chennai-10.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occuring in the course of the study any change in the protocol and patient information / informed consent and asks to be provided a copy of the final report.

CHAIRMAN 28/1/14
Ethical Committee
Govt. Kilpauk Medical College, Chennai

GOVT. KILPAUK MEDICAL COLLEGE
28 JAN 2014
10.